Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2017-453-RC1, 2018

Atmospheric Measurement Techniques Discussions

Interactive comment on "Improved slant column density retrieval of nitrogen dioxide and formaldehyde for OMI and GOME-2A from QA4ECV: intercomparison, uncertainty characterization, and trends" *by* Marina Zara et al.

Anonymous Referee #2

Received and published: 20 March 2018

General Comments:

This paper presented improved slant column density (SCD) retrievals of NO2 and HCHO from the OMI and GOME-2A instruments through a collaborative effort of several different research groups as part of the Quality Assurance for Essential Climate Variables (QA4ECV) project consortium. The QA4ECV SCDs are compared with existing products with a focus on uncertainty characterization using DOAS uncertainties as well as statistical uncertainties based on the spatial variabilities of SCDs in the remote Pacific Ocean, and analysis of trends of uncertainty during long-time periods. The

Printer-friendly version

Discussion paper

evaluation shows the improvement of QA4ECV OMI/GOME-2a NO2 and OMI HCHO products with the smallest DOAS uncertainty and best agreement between DOAS and statistical uncertainties. The SCD uncertainties are smallest for high TOA reflectance due to enhanced signal to noise ratios. OMI SCD uncertainties are shown to be remarkably stable, while GOME-2A SCD uncertainties degrade significantly until heating of the instrument in September 2019 that markedly reduces throughout loss and stabilizing the degradation of SCD uncertainties. This study suggests that the trend detection in GOME and OMI NO2 and HCHO time series is not limited by spectral fittings.

This is an important study to develop high quality long-term data records of NO2 and HCHO, precursors to the ozone and aerosol Essential Climate Variables (ECVs). This scope of the paper is suitable for publication in ACP. It is well written and the analysis is very thorough. Overall, I recommend it to be published after addressing the following minor comments.

Specific Comments:

1. P1, L35, you may add something like “due to higher measurement signal to noise ratio” to explain it.

2. P5, L10, suggest changing the sentence “ . . . is such that . . . is possible” to “ . . . makes . . . possible . . .” to make it more readable

3. P6, L6, suggest changing “achromatic” to “wavelength independent” to make it easier to understand

4. P7, L1, you may add something like “improvement of cloud retrievals using measurements in O2 bands” before “, Additionally” as this is one of the main advantages.

5. P8, L13-14, it was mentioned that high-pass filter is applied. But it is not reflected in equations (1) and (2), probably omitted? Please also clarify if the high-pass filter is applied to the trace gas cross sections.

6. In Tables 2 and 3, it might be useful to add the reference used in the fitting, e.g., average irradiance, monthly average irradiance, daily Earthshine radiance.

7. P12, L20-25, although Sun et al. (2017) shows that the slit function is stable over time, it also shows that derived in-flight slit functions are quite different from pre-launch slit functions especially in terms of cross-track dependence. Has the use of derived slit functions prior to the fit been tested as implemented in the GOME2 algorithms used in this study?

8. P16, Figure 2, what causes the relatively large difference between statistical and DOAS uncertainty in Northern high altitude in OMI data and in Southern high data in GOME-2 data?

9. P17, L19, does A only include absorption cross sections? How about the Jacobian for other parameters like wavelength shift?

10. P17, L25, you may add examples of non-linear parameters in the parenthesis.

11. P19, L8, has V3.1 been released?

12. P20, Figure 3d, why DOAS uncertainty for NASA algorithm does not change much with latitude? Have some of systematic uncertainties been removed in the fitting (e.g., de-striping, common residuals) so that DOAS uncertainties are even smaller for 40S-40N?

13. P25, L19, you may mention “cloud radiance fraction” typically larger than “cloud fraction” so that clear-sky values are still slightly larger than all-sky values.

14. P29, L6-11, it is interesting to note from Figure 8b that DOAS SCD uncertainties seem to be smaller for those extreme off-nadir pixels in OMINO2-QA4ECV product. Is this due to increasing viewing zenith angle that increases reflectance as a result of multiple scattering?

15. P32, L13-15, this sentence is not clear, suggest rephrasing it. For example, it is

not clear whether using annual mean increases or decreases the strips by saying “it manifests”

16. P39, L33-34, suggest rephrasing this sentence there is not cause-effect relationship between increasing SCD uncertainties and stability of stratospheric and tropospheric retrievals.

Technical comments

1. P6, L11, change “absorption signature” to “absorption signatures”
2. P7, L3, add “in” before “September”
3. P11, L16, change the second “stretch” to “squeeze”
4. P14, L12, change “prior” to “prior to”
5. P19, L2, change “extend” to “extent”
6. P39, L27, add “those” before “over bright scenes”

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2017-453, 2018.

Printer-friendly version

Discussion paper